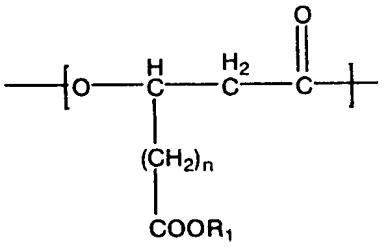
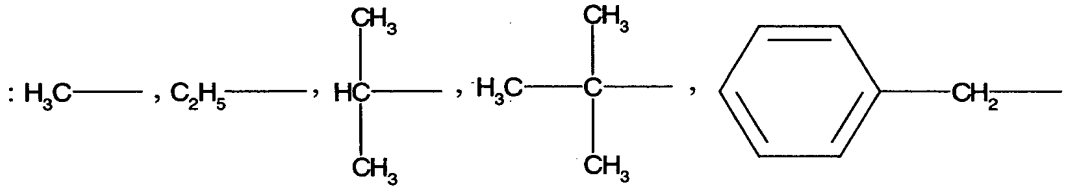
CLAIMS

1. In a charge control agent for controlling a charge of powder or granules, wherein the charge control agent comprises a polyhydroxyalkanoate having at least one kind of 3-hydroxy-ω-carboxyalkanoic acid unit represented by the chemical formula (1):



n = 1-8 (1)

wherein n is an integer selected from the range shown in the same chemical formula; R_1 is an H, Na or K atom, or

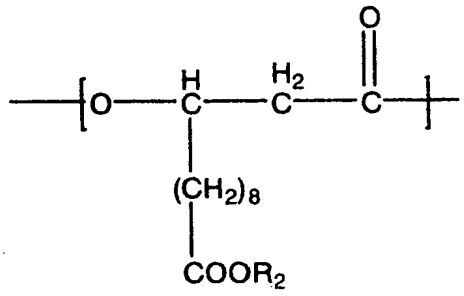


and when more than one unit exists, n and R_1 may differ from unit to unit.

2. The charge control agent according to claim 1, wherein the 3-hydroxy-ω-carboxyalkanoic acid unit represented by the chemical formula (1) includes any one or more selected from the group consisting

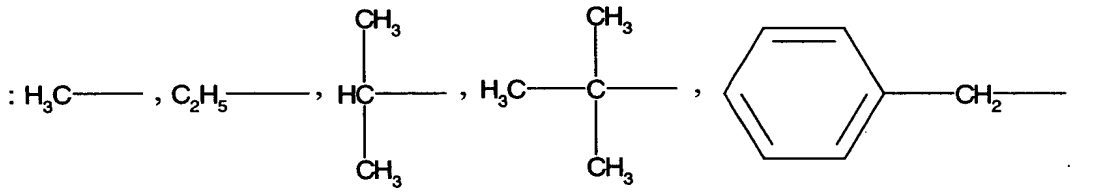
of:

a 3-hydroxy-11-carboxyundecanoic acid unit represented by the chemical formula (2):



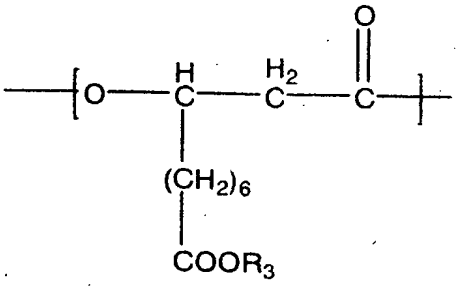
(2)

wherein R_2 is an H, Na or K atom, or



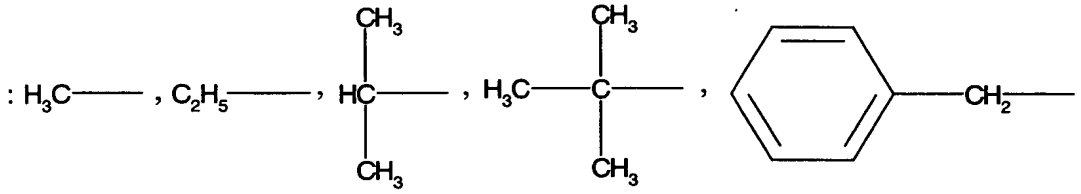
and when more than one unit exists, R_2 may differ from unit to unit,

a 3-hydroxy-9-carboxynonanoic acid unit represented by the chemical formula (3):



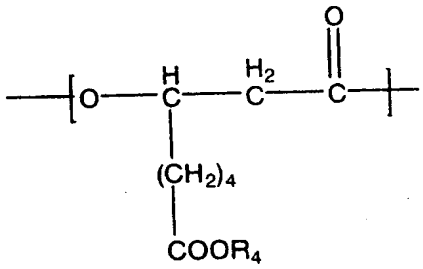
(3)

wherein R_3 is an H, Na or K atom, or



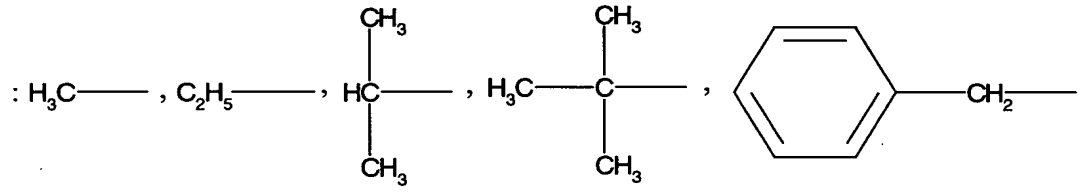
and when more than one unit exists, R_3 may differ from unit to unit,

a 3-hydroxy-7-carboxyheptanoic acid unit represented by the chemical formula (4):



(4)

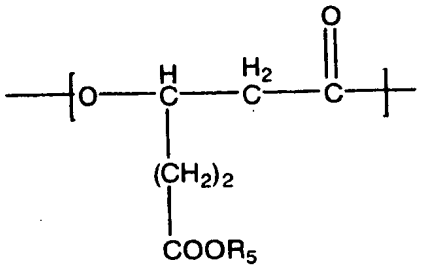
wherein R_4 is an H, Na or K atom, or



and when more than one unit exists, R_4 may differ from unit to unit,

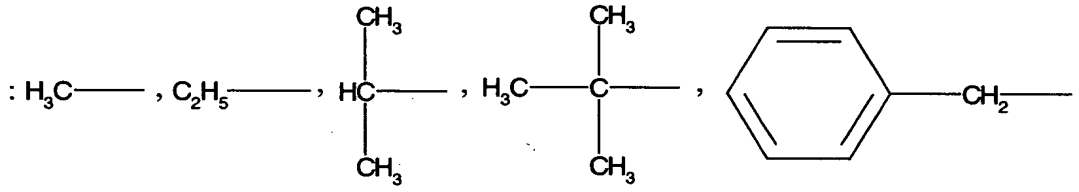
and

a 3-hydroxy-5-carboxyvaleric acid unit represented by the chemical formula (5):



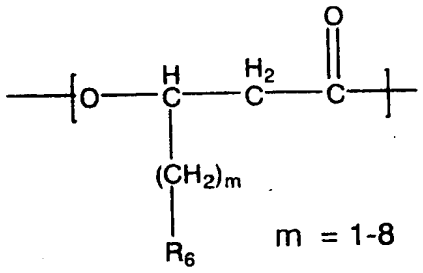
(5)

wherein R_5 is an H, Na or K atom, or



and when more than one unit exists, R_5 may differ from unit to unit.

3. The charge control agent according to claim 1, characterized by comprising a polyhydroxyalkanoate that may have, besides at least one kind of 3-hydroxy-ω-carboxyalkanoic acid represented by the chemical formula (1), a 3-hydroxy-ω-alkanoic acid unit represented by the chemical formula (6):

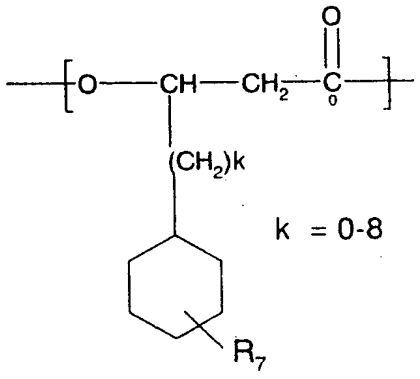


(6)

wherein m is an integer selected from the range shown in the same chemical formula; R_6 comprises a residue having either a phenyl structure or a thienyl structure; and when more than one unit exists, m and R_6 may differ from unit to unit,

or

a 3-hydroxy-ω-cyclohexylalkanoic acid unit represented by the chemical formula (7):

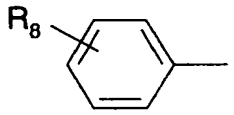


(7)

wherein R_7 represents a substitute in the cyclohexyl group and is an H atom, a CN group, an NO_2 group, a

halogen atom, a CH_3 group, a C_2H_5 group, a C_3H_7 group, a CF_3 group, C_2F_5 group or a C_3F_7 group; and k is an integer selected from the range shown in the same chemical formula, and when more than one unit exists, R_7 and k may differ from unit to unit.

4. The charge control agent according to claim 1, characterized in that R_6 in the chemical formula (6), namely a residue having either a phenyl or thienyl structure has at least any one chemical formula selected from the group consisting of chemical formulae (8), (9), (10), (11), (12), (13), (14), (15), (16), (17) and (18), and when more than one unit exists, R_6 may differ from unit to unit, wherein
the chemical formula (8) is a group consisting of unsubstituted and substituted phenyl groups represented by:

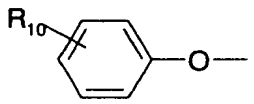


(8)

wherein R_8 represents a substituent on the aromatic ring and is an H atom, a halogen atom, a CN group, an NO_2 group, a CH_3 group, a C_2H_5 group, a C_3H_7 group, a $CH=CH_2$ group, $COOR_9$ (R_9 represents any one of H, Na

and K atoms), a CF_3 group, a C_2F_5 group or a C_3F_7 group, and when more than one unit exists, R_8 may differ from unit to unit,

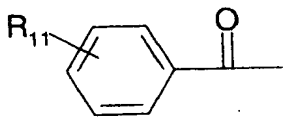
the chemical formula (9) is a group consisting of unsubstituted and substituted phenoxy groups represented by:



(9)

wherein R_{10} represents a substituent on the aromatic ring and is an H atom, a halogen atom, a CN group, an NO_2 group, a CH_3 group, a C_2H_5 group, a C_3H_7 group, an SCH_3 group, a CF_3 group, a C_2F_5 group or a C_3F_7 group, and when more than one unit exists, R_{10} may differ from unit to unit,

the chemical formula (10) by a group consisting of unsubstituted and substituted benzoyl groups represented by:

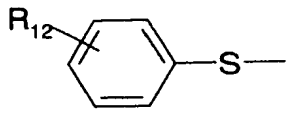


(10)

wherein R_{11} represents a substituent on the aromatic ring and is an H atom, a halogen atom, a CN group, an NO_2 group, a CH_3 group, a C_2H_5 group, a C_3H_7 group, a

CF_3 group, a C_2F_5 group or a C_3F_7 group, and when more than one unit exists, R_{11} may differ from unit to unit,

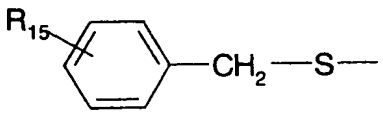
the chemical formula (11) is a group consisting of unsubstituted and substituted phenylsulfanyl groups represented by:



(11)

wherein R_{12} represents a substituent on the aromatic ring and is an H atom, a halogen atom, a CN group, an NO_2 group, a $COOR_{13}$, an SO_2R_{14} (R_{13} represents any one of an H atom, an Na atom, a K atom, a CH_3 group and a C_2H_5 group and R_{14} represents any one of an OH group, an ONa group, an OK group, a halogen atom, an OCH_3 group and OC_2H_5 group), a CH_3 group, a C_2H_5 group, a C_3H_7 group, a $(CH_3)_2$-CH group or a $(CH_3)_3$-C group, and when more than one unit exists, R_{12} may differ from unit to unit,

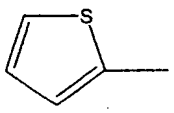
the chemical formula (12) is a group consisting of unsubstituted and substituted (phenylmethyl)sulfanyl groups represented by:



(12)

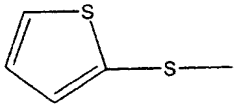
wherein R_{15} represents a substituent on the aromatic ring and is an H atom, a halogen atom, a CN group, an NO_2 group, a $COOR_{16}$, an SO_2R_{17} (R_{16} represents any one of an H atom, an Na atom, a K atom, a CH_3 group and a C_2H_5 group and R_{17} represents any one of an OH group, an ONa group, an OK group, a halogen atom, an OCH_3 group and OC_2H_5 group), a CH_3 group, a C_2H_5 group, a C_3H_7 group, a $(CH_3)_2$-CH group or a $(CH_3)_3$-C group, and when more than one unit exists, R_{15} may differ from unit to unit,

the chemical formula (13) is a 2-thienyl group represented by:



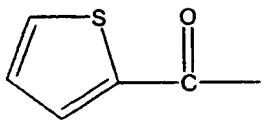
(13)

the chemical formula (14) is a 2-thienylsulfanyl group represented by:



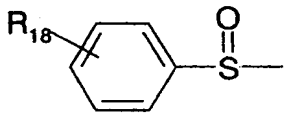
(14)

the chemical formula (15) is 2-thienylcarbonyl group represented by:



(15)

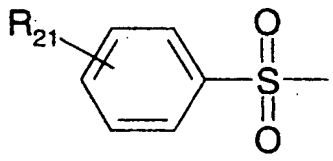
the chemical formula (16) is a group consisting of unsubstituted and substituted phenylsulfinyl groups represented by:



(16)

wherein R_{18} represents a substituent on the aromatic ring and is an H atom, a halogen atom, a CN group, an NO_2 group, a $COOR_{19}$, an SO_2R_{20} (R_{19} represents any one of an H atom, an Na atom, a K atom, a CH_3 group and a C_2H_5 group and R_{20} represents any one of an OH group, an ONa group, an OK group, a halogen atom, an OCH_3 group and OC_2H_5 group), a CH_3 group, a C_2H_5 group, a C_3H_7 group, a $(CH_3)_2$-CH group or a $(CH_3)_3$-C group, and when more than one unit exists, R_{18} may differ from unit to unit,

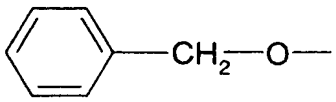
the chemical formula (17) is a group consisting of unsubstituted and substituted phenylsulfonyl groups represented by:



(17)

wherein R_{21} represents a substituent on the aromatic ring and is an H atom, a halogen atom, a CN group, an NO_2 group, a $COOR_{22}$, an SO_2R_{23} (R_{22} represents any one of an H atom, an Na atom, a K atom, a CH_3 group and a C_2H_5 group and R_{23} represents any one of an OH group, an ONa group, an OK group, a halogen atom, an OCH_3 group and OC_2H_5 group), a CH_3 group, a C_2H_5 group, a C_3H_7 group, a $(CH_3)_2$-CH group or a $(CH_3)_3$-C group, and when more than one unit exists, R_{21} may differ from unit to unit,

the chemical formula (18) is a group of a (phenylmethyl)oxy group represented by:



(18)

5. The charge control agent according to claim 1, wherein the powder and granular material is a toner for developing electrostatic charge images.

6. The charge control agent according to claim 1, wherein the number average molecular weight

of the polyhydroxyalkanoate is in the range of 1,000 to 1,000,000.

7. In a toner binder used for a toner for developing electrostatic charge images, characterized by comprising the charge controlling agent according to any one of claims 1 to 6.

8. A toner for developing electrostatic charge images, characterized by comprising at least a binder resin, a colorant and the charge control agent according to any one of claims 1 to 6.

9. An image forming method, comprising at least a charging step of charging an electrostatic latent image carrier by applying voltage to a charging member from the outside; an electrostatic charge image forming step of forming an electrostatic charge image on the charged electrostatic latent image carrier; a developing step of developing the electrostatic charge image with a toner for developing electrostatic charge images to form a toner image on the electrostatic latent image carrier; a transferring step of transferring the toner image on the electrostatic latent image carrier to a recording medium; and a fixing step of fixing the toner image on the recording medium by heat,

characterized in that it uses at least a binder resin, a colorant and the charge control agent according to any one of claims 1 to 6.

10. The image forming method according to claim 9, characterized in that the transferring step comprises a first transferring step of transferring the toner image on the electrostatic latent image carrier to an intermediate transfer medium; and a second transferring step of transferring the toner image on the intermediate transfer medium to a recording medium.

11. An image forming apparatus, comprising at least charging means of charging an electrostatic latent image carrier by applying voltage to a charging member from the outside; electrostatic charge image forming means of forming an electrostatic charge image on the charged electrostatic latent image carrier; developing means of developing the electrostatic charge image with a toner for developing electrostatic charge images to form a toner image on the electrostatic latent image carrier; transferring means of transferring the toner image on the electrostatic latent image carrier to a recording medium; and fixing means of fixing the toner image on the recording medium by heat,

characterized in that it uses at least a binder resin, a colorant and the charge control agent according to any one of claims 1 to 6.

12. The image forming apparatus according to claim 11, characterized in that the transferring means comprises first transferring means of transferring the toner image on the electrostatic latent image carrier to an intermediate transfer medium; and second transferring means of transferring the toner image on the intermediate transfer medium to a recording medium.

13. A charge controlling method, characterized by comprising the steps of preparing the charge controlling agent according to any one of claims 1 to 6; and controlling the charged state of a toner using the charge controlling agent.